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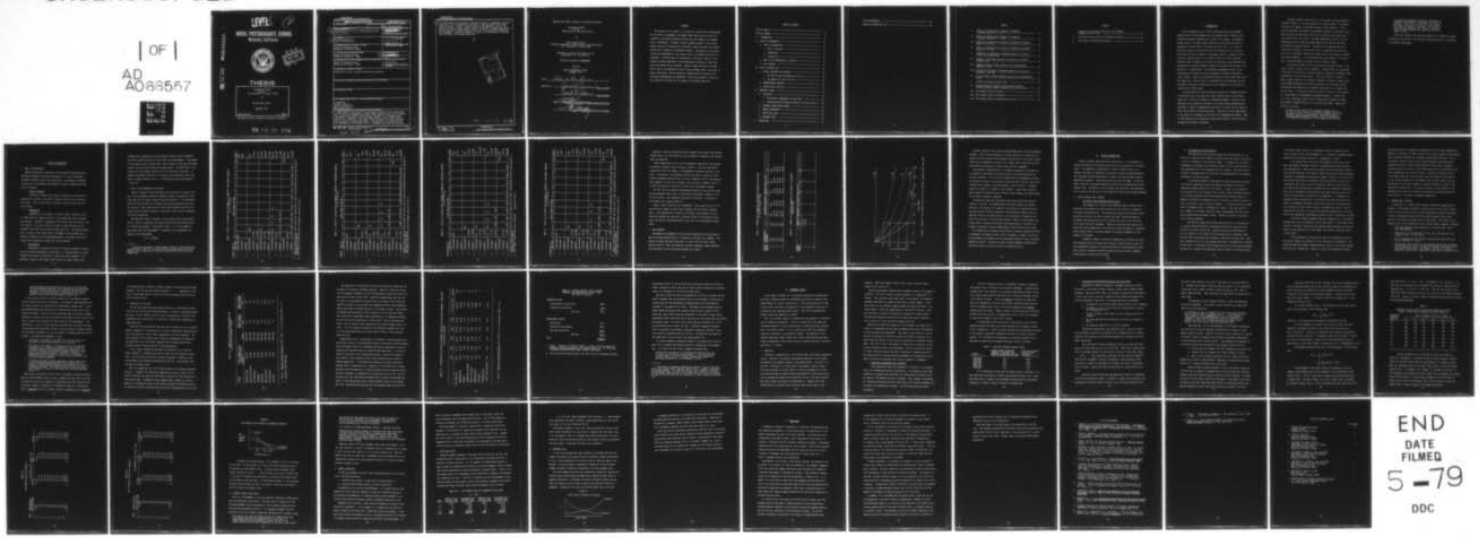

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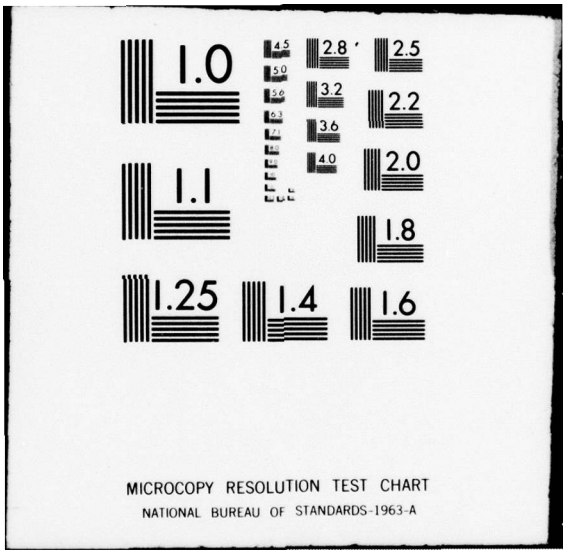
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NAVAL POSTGRADUATE SCHOOL
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THESIS

DISCOUNTING THEORY
AND ITS
APPLICATION IN THE PUBLIC SECTOR

by

Ralph Anthony Bonna

December 1978

Thesis Advisor: J. F. OWENS

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The purpose of this paper is to review the current policy established by the Office of Management and Budget (OMB) concerning the use of discounting in evaluating time-distributed costs and benefits of proposed public investments. Although a widely accepted concept in the private sector, the use of discounting in the public sector has been less clearly defined and a subject of considerable debate. The mechanics of discounting and the importance of the discount rate in investment decisions are discussed.

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A brief history of discounting in the public sector is presented including highlights of the Congressional Hearings in 1968 from which the current policy resulted. Several issues relating to the OMB policy such as the question of social versus economic goals, the effect of budget constraints, and the potential misapplication or misuse of the discounting methodology are addressed. Particular attention is given to the problem of inflation and its impact on the established rate.

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Discounting Theory and its Application in the Public Sector

by

Ralph Anthony Bonna
Lieutenant Commander, Supply Corps, United States Navy
B.S., University of Maine, 1968

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

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December 1978

Author Ralph Anthony Bonna

Approved by: Joseph F. Queenan
Thesis Advisor

Robert D. Reasker
Second Reader

Chairman, Department of Administrative Sciences

Dean of Information and Policy Sciences

ABSTRACT

The purpose of this paper is to review the current policy established by the Office of Management and Budget (OMB) concerning the use of discounting in evaluating time-distributed costs and benefits of proposed public investments. Although a widely accepted concept in the private sector, the use of discounting in the public sector has been less clearly defined and a subject of considerable debate. The mechanics of discounting and the importance of the discount rate in investment decisions are discussed. A brief history of discounting in the public sector is presented including highlights of the Congressional Hearings in 1968 from which the current policy resulted. Several issues relating to the OMB policy such as the question of social versus economic goals, the effect of budget constraints, and the potential misapplication or misuse of the discounting methodology are addressed. Particular attention is given to the problem of inflation and its impact on the established rate.

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I. INTRODUCTION

Sound investment policy in both private business and government requires that the decisionmaker know the expected rate of return on the alternative projects competing for a share of his budget. Investments, whether public or private, commit resources in the future and carry an expectation of gains which will materialize over time. It is the expectation of gains and costs which will be realized only in the future which pose the crucial problem in investment analysis. Because a dollar expected a decade from now is not worth as much as a dollar expected tomorrow, even if general price levels do not change, some procedure must be employed for placing streams of benefits and costs with different time patterns on a common basis. The procedure recommended by most for accomplishing this common time basis adjustment is known as discounting. Simply stated, it works by ascertaining how much a dollar held today could be turned into in future years if invested wisely and then applying this adjustment to dollars of gains and costs not expected to be received or incurred until future years.

The applicability of the discounting concept to investment decisions in the public sector has been less clearly defined than in the private sector and in the past a subject of considerable debate. The most often addressed issues centered on whether or not the discount methodology was applicable to public investment decisions and if so what rate (or range of rates) would lead to the best decisions. The official policy promulgated by the Bureau of the Budget (now the Office of Management and Budget - OMB) in 1969 supported the discounting concept and required a 10% rate be used throughout the Federal Government.

It might be asked at this point - if the policy has been mandated in the public sector, is it worth pursuing this issue further? Two reasons in particular support an affirmative answer to this question. First, when one considers the budget of the Federal Government, each year crucial decisions must be made involving billions of dollars to be spent both in the present and in the future. The sheer magnitude of dollars involved necessitate that the funds be appropriated to only the most efficient and effective projects possible. Although the ultimate decisions are legislated by Congress, the raw data which is submitted during the budget cycle is developed, analyzed and ranked within the context of guidance from higher authority. It is submitted that a key element in this guidance is the requirement to discount future streams of funds.

A second and related reason for pursuing this matter relates to the issue of public versus private investment. Projects which are undertaken in the public sector have an indirect impact on potential investments under consideration in the private sector. Since the decision to invest in a public project requires the raising of revenues principally through taxes, funds become transferred out of the private and into the public sector. The discount rate employed by the Federal Government is an integral part of this issue. A low discount rate (e.g. 2%) will result in the approval of a large number of governmental investment projects. A higher rate (e.g. 15%), conversely, would filter out many public projects allowing for greater investment flexibility in the private sector. Baumol summarizes it this way.

> At stake in the choice of an acceptable discount rate is no less than the allocation of resources between the private and public sectors of the economy. The discount rate, by indicating what government projects should be undertaken, can determine the proportion of the economy's activity that

> is operated by governmental agencies, and hence the proportion that remains in the hands of private enterprise. With so much at issue it is well worth the effort to explore in some detail the principles that should be employed in arriving at a discount figure and the rationale that underlies those principles. [1:201]

Within this context, the following chapters will attempt to present an objective discussion of the important issues pertaining to discounting in the Federal Government.

II. ROLE OF DISCOUNTING

A. WHAT IS DISCOUNTING?

Before undertaking a discussion of the current discounting policy employed throughout the Federal Government, it is first considered necessary to define certain key terminology. The concepts introduced are basic but are presented nevertheless to ensure a common base from which to proceed.

1. Rate of Interest

The rate of interest can simply be defined as the per cent of premium paid on money at one date in terms of money to be on hand one year later. That is, the rate of interest is the price paid for the use of money.

2. Compounding

Compounding is the growth in value of funds invested to yield an income when the income received is not consumed but itself retained and invested. Interest is computed on the original sum at the end of the first period. The new and larger principal is then the base for the interest calculation for the second period and so on. The growing amount that is found at later times from an investment at the present time is therefore referred to as the compounded amount. The higher the rate of interest the increasingly greater the values obtained.

3. Discounting

Discounting is simply the reverse of computing compound interest. Its use discloses the amount of money which, if invested today at a given interest rate, would be sufficient to meet future cash payments. Discounting is based on the concept that a dollar not spent today can be

invested until needed and that the interest earned on such investments can then be used to pay part of the future cash requirements. For example, if the interest rate is 5% per year, then to obtain $1 one year from today requires that only 95.24 cents be invested today. The 95.24 cents is referred to as the "present value" of $1 to be received in one year. In general the present value (PV) of X dollars to be received t years from now at a simple interest rate of r is obtained by solving the equation $X = PV(1+r)^t$.

B. WHAT IS THE IMPORTANCE OF THE RATE?

Tables I through IV show the effect that the choice of interest rate has on the investments needed now (present values) to accumulate to the total required for several mutually exclusive options.[1] The differences arise from the fact that the interest rate chosen determines the return for any year. When larger returns (from larger interest rates) are allowed to accrue further interest, a relatively small initial investment can quickly accumulate.

The potential impact of changes in the discount rate on the present value is seen by considering the equation which gives the present value of a future disbursement. The discount rate is i, t is the number of years hence that the disbursement is scheduled, and $ represents the amount of the disbursement.

$$PV = \frac{\$}{(1 + i)^t}$$

---

[1] The term disbursement in these examples refers to the undiscounted cash outflows for each of the options while investment denotes the discounted value in year zero of the cash outflows occurring in years one through ten.

TABLE I EFFECT OF DISCOUNT RATE ON AMOUNT OF IMMEDIATE INVESTMENT REQUIRED
(r of 3 Percent)

OPTION	TYPE OF CASH FLOW	CASH FLOW IN YEAR 0	1	2	3	4	5	6	7	8	9	10	Total
	Disbursement	100.											100.
1	Investment												100.[b]
	Interest												
	Disbursement		100.										100.
2	Investment	97.09											97.09
	Interest	2.91											2.91
	Disbursement	55.00	55.										110.00
3	Investment	53.40											108.40[b]
	Interest	1.60											1.60
	Disbursement	25.00	25.	25.	25.	25.							125.00
4	Investment	92.93											117.93[b]
	Interest	2.79	2.12	1.44	0.73								7.07[a]
	Disbursement											200.	200.00
5	Investment	148.82											148.82
	Interest	4.46	4.60	4.74	4.88	5.02	5.18	5.33	5.49	5.66	5.83		51.18[a]

a. Interest figures may not exactly equal the actual sums of their corresponding interest rows because of rounding-off of numbers.
b. This figure reflects the total investment required in Year 0.

TABLE II EFFECT OF DISCOUNT RATE ON AMOUNT OF IMMEDIATE INVESTMENT REQUIRED
(r of 10 Percent)

OPTION	TYPE OF CASH FLOW	CASH FLOW IN YEAR 0	1	2	3	4	5	6	7	8	9	10	Total
	Disbursement	100.											100.
1	Investment												100.[b]
	Interest												
	Disbursement		100.										100.
2	Investment	90.91											90.91
	Interest	9.09											9.09
	Disbursement	55.	55.										110.
3	Investment	50.00											105.00[b]
	Interest	5.00											5.00
	Disbursement	25.	25.	25.	25.	25.							125.
4	Investment	79.25											104.25[b]
	Interest	7.92	6.22	4.34	2.27								20.75
	Disbursement											200.	200.
5	Investment	77.10											77.10
	Interest	7.71	8.48	9.33	10.26	11.29	12.42	13.66	15.02	16.53	18.18		122.90[a]

a. Interest figures may not exactly equal the actual sums of their corresponding interest rows because of rounding-off of numbers.
b. This figure reflects the total investment required in Year 0.

TABLE III EFFECT OF DISCOUNT RATE ON AMOUNT OF IMMEDIATE INVESTMENT REQUIRED
(r of 15 Percent)

OPTION	TYPE OF CASH FLOW	CASH FLOW IN YEAR 0	1	2	3	4	5	6	7	8	9	10	Total
	Disbursement	100.											100.
1	Investment												100.[b]
	Interest												
	Disbursement		100.										100.
2	Investment	86.96											86.96
	Interest	13.04											13.04
	Disbursement	55.	55.										110.
3	Investment	47.83											102.83[b]
	Interest	7.17											7.17
	Disbursement	25.	25.	25.	25.	25.							125.
4	Investment	71.38											96.38[b]
	Interest	10.71	8.56	6.10	3.26								28.62[a]
	Disbursement											200.	200.
5	Investment	49.44											49.44
	Interest	7.42	8.53	9.81	11.28	12.97	14.92	17.15	19.73	22.69	26.09		150.56[a]

a. Interest figures may not exactly equal the actual sums of their corresponding interest rows because of rounding-off of numbers.
b. This figure reflects the total investment required in Year 0.

TABLE IV EFFECT OF DISCOUNT RATE ON AMOUNT OF IMMEDIATE INVESTMENT REQUIRED
(r of 20 Percent)

OPTION	TYPE OF CASH FLOW	CASH FLOW IN YEAR 0	1	2	3	4	5	6	7	8	9	10	Total
1	Disbursement	100.											100.
	Investment												100.[b]
	Interest												
2	Disbursement		100.										100.
	Investment	83.33											83.33
	Interest	16.67											16.67
3	Disbursement	55.	55.										110.
	Investment	45.83											100.83[b]
	Interest	9.17											9.17
4	Disbursement	25.	25.	25.	25.	25.							125.
	Investment	64.72											89.72[b]
	Interest	12.94	10.53	7.64	4.17								35.28
5	Disbursement											200.	200.
	Investment	32.30											32.30
	Interest	6.46	7.75	9.30	11.16	13.40	16.07	19.29	23.15	27.78	33.33		167.70[a]

a. Interest figures may not exactly equal the actual sums of their corresponding interest rows because of rounding-off of numbers.
b. This figure reflects the total investment required in Year 0.

Because an inverse relationship exists between the discount rate and the present value, the rate chosen can have a powerful influence on the analysis under consideration.

Direct comparisons of the initial investments required for the options at differing interest rates are given in Table V. For any given option (except the first) the change in the immediate investment required is dramatic. For Option 4, for example, with the low rate of return of 3% for interim investment opportunities, $117.93 is needed to fulfill the disbursement schedule. As the rate increases, less and less is needed in year 0; at 20%, only $89.72 is required to fulfill the disbursement schedule.

For this set of alternative disbursement patterns to the problem, then, the decisionmaker would order his preferences differently (except for the 3% and 5% rates) - and sometimes drastically differently - according to the interest rate chosen (Table VI).

Figure 1 helds illustrate this phenomenon. The present value of $1 at any particular number of years hence, changes with the varying interest rates. The compounding of interest at different rates accounts for this. Since the interest can have such a profound effect on the ranking of projects, the nature and determination of the rate is of considerable significance.

C. WHY DISCOUNT?

Government decisionmakers long have been concerned with the problem of how to evaluate appropriately all alternative solutions to a problem. This question assumes even more importance in view of the fact that, from a national point of view, the resources available (manpower, money, machines, and technology) to solve existing problems are limited.

TABLE V COMPARISON OF IMMEDIATE INVESTMENTS REQUIRED FOR OPTIONS AT VARYING INTEREST RATES

OPTION NUMBER	DISBURSEMENT REQUIRED	INVESTMENT REQUIRED, DISCOUNT RATE (%) OF:					
		0	3	5	10	15	20
1	100.	100.	100.	100.	100.	100.	100.
2	100.	100.	97.09	95.24	90.91	86.96	83.33
3	110.	110.	108.40	107.38	105.00	102.83	100.83
4	125.	125.	117.93	113.65	104.25	96.38	89.72
5	200.	200.	148.82	122.78	77.10	49.44	32.30

TABLE VI CHANGES IN PREFERENCE RANKINGS FOR OPTIONS AT DIFFERENT INTEREST RATES

OPTION NUMBER	ORDER OF PREFERENCE AT INTEREST RATE (%) OF:					
	0	3	5	10	15	20
1	1.5(Tie)	2	2	3	4	4
2	1.5(Tie)	1	1	2	2	2
3	3	3	3	5	5	5
4	4	4	4	4	3	3
5	5	5	5	1	1	1

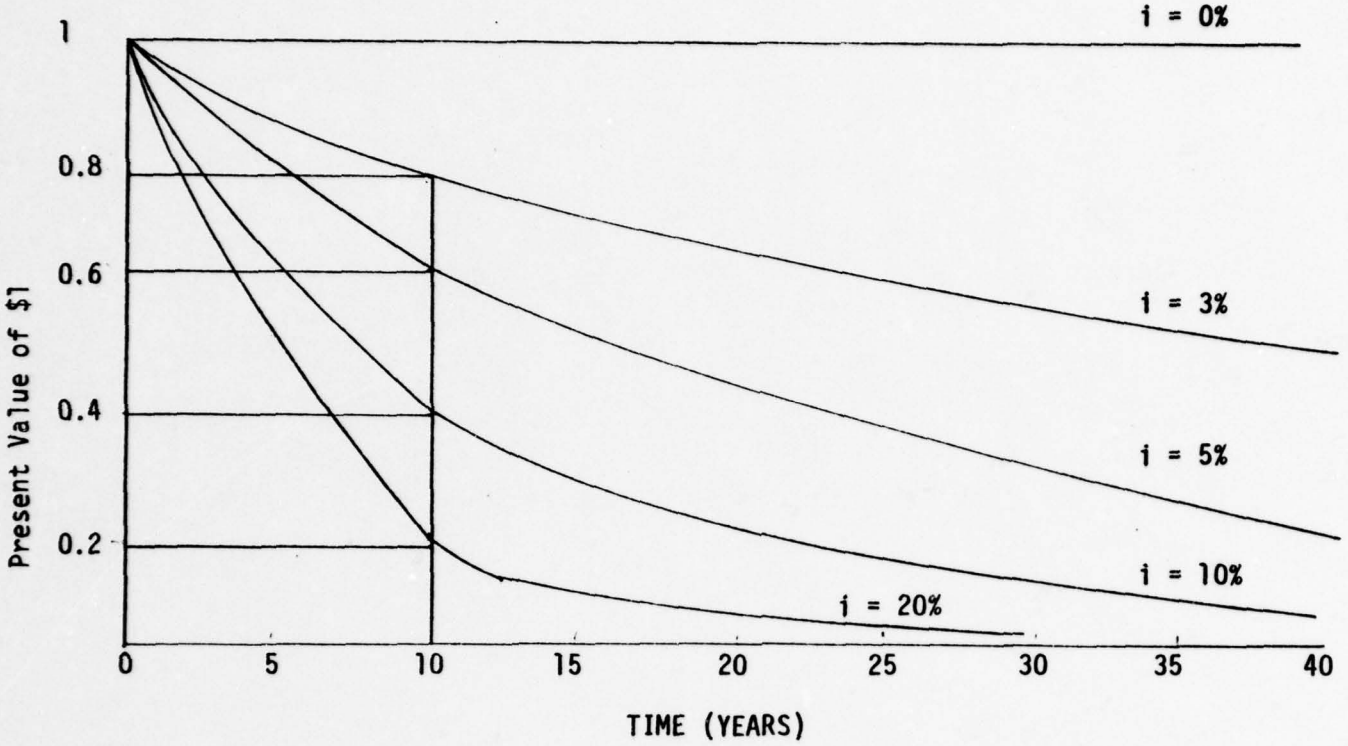

Figure 1 Changes in the present value of $1 for different interest rates over time.

National resources must then be allocated among the various governmental programs. Each of these programs is (either explicitly or implicitly) assigned a priority based on the program's contribution to the nation's goals. High-priority programs are usually fully funded, while lower-priority program funds are eliminated or reduced from the level requested.

Each program's administrator is ultimately responsible for maximizing his program's contribution to national goals while minimizing drain on national resources. This is done by determining and recommending the most cost effective project in attaining a particular goal (solving a particular problem) which supports the administrator's overall mission. A program typically consists of a number of such projects. Should one or more of these supporting projects be less effective than planned, the effectiveness of the overall program is impaired.

A program that does not contribute sufficiently generally suffers a decrease in funding. The administrator then must operate with reduced funds and still maintain his capability to achieve his objectives as effectively and efficiently as possible. Before seeking funding, then an important input to the administrator is the evaluation of competing projects from the point of view of each project's impact on the economy, the private sector (taxpaying individuals and organizations, from which the funding is obtained), mission effectiveness, and efficient use of funds.

The discounting (or present value analysis) procedure required by Office of Management and Budget Circular A-94 is intended, in theory, to provide the government decisionmaker with an additional analytical tool to evaluate competing projects. Discounting allows the decisionmaker to make direct comparisons using the single criterion of present dollars.

III. SOCIAL DISCOUNT RATE

In order to better understand the current policy, it is worthwhile to review the history of discounting particularly as it pertains to the public sector. The question of establishing a "social" discount rate (i.e. a discount rate which is applicable to the public sector) has been among the most discussed and most controversial issues in the entire area of public expenditure economics. During the period from the late 1950s to the late 1960s there was considerable debate on exactly how to determine the social discount rate. Two general social discount rate positions, the opportunity cost of capital and the social time preference, were the most often presented.

A. SOCIAL DISCOUNT RATE THEORIES

1. The Social Time Preference Position [2]

The argument for a social time preference public discount rate is premised on the proposition that provision for the future is a commodity with public characteristics. This proposition assumes the privately experienced gains and costs on which citizens form their savings-consumption-borrowing-investing decisions fail to reflect the social gains and costs which accrue from such investment. Because private decisions neglect providing for future generations, the level of private investment is suboptimal. Simply stated, there is too much emphasis on present consumption at the expense of investment.

Although a number of corrective remedies are available, the social time preference position argues that the public sector should increase its own investment by adopting a discount rate which is below observed private sector rates, a discount rate which reflects the social desire (somehow ascertained) to provide for the future.

2. The Opportunity Cost Position

The opportunity cost position argues that the government in its role as an investor should attempt to maximize the well-being of the nation as this is reflected in the national income. It proposes that no public investment be undertaken which produces outputs of less value than that of the alternative use of the resources which it absorbs. The social return on public investments must at least equal that experienced on the spending displaced in the private sector.

In bestowing normative significance on the private sector behavior, this position completely avoids the question of whether the society is undertaking enough provision for the future. It does so by recognizing that the function of the discount rate in public sector investment analysis is to reflect accurately the private opportunities forgone in each of a number of alternative investments and not to serve as a vehicle by which to alter the society's rate of capital formation. It leaves that task to other social instruments such as investment tax credits. This basic position has a number of variations from which result disagreement over what really gets displaced when government invests. Several are briefly discussed in the following paragraphs.

One position argues that private sector activity is displaced and its returns forgone when public investments divert real inputs from the private to the public sector [3]. Because such factor displacement implies a reduction in the output of both consumption and investment goods, the sacrifices implied must be reflected in the social discount rate. However, because the value of the consumer sacrifices is automatically reflected in the profits of business firms through the prices at which goods exchange, one has only to observe the before-tax rates of returns in private business.

In averaging these rates so as to generate an empiric estimate of the social discount factor, the breakdown of U. S. business investment between corporate and noncorporate business is suggested as a guide.

In a second view, costs which are imposed on the private sector when the Federal Government finances its expenditures through borrowing are considered [4]. These costs are caused by the private credit restriction and the additional saving which results from capital market adjustment processes to accommodate the new public demand. Hence it is the real cost of borrowed funds which has normative significance and this real cost is indicated by the rates of return (including a return to cover taxes) on the corporate and noncorporate investment and the residential construction which gets eliminated by the additional government borrowing and by the rates on the additional savings which are generated. To implement this conceptual position empirically, the analyst must trace the restrictive effect of government borrowing on the various sectors of the capital market, estimate the real value of capital investment and saving in each of these sectors and finally calculate the weighted average value of private capital and consumption displacements caused by public borrowings as weights.

The basic difference between these two concepts lies in the vehicle through which costs are imposed on the private sector. In the latter, the vehicle is the public borrowing that tightens capital markets and restricts credit to other sectors and in the former, the vehicle is the extraction of real inputs.

A third opportunity cost position looks to yet another set of private sector impacts for guidance in social discount rate estimation. This position argues that federal expenditures are paid for by the taxes through which they are financed [5]. Hence it is the private spending displaced

by these taxes which represents the opportunity cost of public expenditure. Because the incidence of federal taxes falls on both consumers and businesses, both consumption spending and investment spending get displaced. The private sector interest rates relating to both household saving-borrowing-consuming decisions (private time preference) and business investment-borrowing decisions (rates of return before taxes) must be reflected in the social opportunity cost rate of discount. Empirical estimation of this rate requires that the relevant federal taxes be traced to their sources in the various subsectors of the household and business sectors and then be weighted by the relative amounts of spending displaced in each by the imposition of those taxes. The social discount rate then appears as the weighted rate of return or private sector spending displaced through the taxes implicit in the public investment expenditure.

B. CONGRESSIONAL HEARINGS

In 1968 the U. S. Congress Joint Economic Committee, Subcommittee on Economics in Government undertook a detailed review of the issue of determining a social discount rate to be used throughout the Federal Government. A study by the General Accounting Office (GAO) presented during these hearings illustrated the urgent need for such action. This report, which summarized the use of discounting used by various federal agencies, revealed:

1. Ten of 23 agencies used discounting in evaluating their fiscal year 1969 programs.

2. Eight did not use discounting in fiscal year 1969 decisions, but planned to use it in the future.

3. Five of the agencies did not use discounting and stated that they had no intentions of using it.

4. The discount rates used by the ten agencies who employed discounting varied from 3% to 12% and a variety of rationales were used to support the different rates. For example, the Office of Economic Opportunity used rates of three and five per cent to evaluate the Job

> Corps and Upward Bound programs and five per cent to evaluate the family planning program. The rationale for selecting these rates was that they were safely on the conservative side for estimates of this type and gave consideration of the secular growth in the price of quality-constant labor [6:5].

It was obvious from this and other reports that the federal agencies applied discounting at their discretion. Furthermore, there apparently was no unique rationale for determining the appropriate interest rate. A common understanding concerning the use of discounting did not exist in the Federal Government. During a series of hearings held by the Joint Economic Committee, witnesses from various agencies and economic advisors were called upon to analyze the situation and offer solutions and improvements. The Committee as a result of these hearings concluded that consistent discounting procedures and appropriate interest rate policy must be adopted throughout the Federal Government if wise and economic investment decisions are to be made. The Committee recommended in part:

1. The Bureau of the Budget (now OMB) insist on the adoption of consistent discounting procedures by all agencies;

2. The Bureau of the Budget, in conjunction with an appropriate Government agency, immediately undertake a study to develop a method of estimating the weighted average opportunity cost of private spending displaced by government investment. This method should recognize that the financing of the Federal Government entails a reduction in both private consumption and private investment spending;

3. An appropriate Federal agency undertake an ongoing publication of this weighted-average opportunity cost interest rate as guidance to those agencies applying discount analysis to public investment decisions. The interest rate calculation and publication should be pursuant to and based upon the above-mentioned study [7:1].

OMB Circular A-94 dated 27 March 1972 to the Heads of Executive Departments and Establishments provides such a standard discount rate to be used in evaluating costs and/or benefits of Government decisions concerning the initiation, renewal or expansion of programs and projects. The discount rate is <u>suggested</u> for use in internal planning of agencies but is <u>required</u>

for program analysis submitted to OMB in support of legislative and budget programs. The 10% rate was selected because it " . . . represents an estimate of the average rate of return on private investment before taxes and after inflation" [8:4].

C. DERIVATION OF THE RATE

The 10% rate established was based primarily on a study done by Stockfisch for the Institute for Defense Analyses. In order to understand better the basis for the current rate and to gain an appreciation of some of the assumptions which were made in its derivation, Stockfisch's methodology is summarized below.

Stockfisch took the position that the rate-of-return, or cost of capital measure, employed in the evaluation or costing of government programs should equal the before-tax rate of return generated by private investment. The basic approach of his analysis was to develop a methodology for measuring the opportunity cost of private investment and to present quantitative estimates based on the application of that methodology.

In this regard, Stockfisch used what he referred to as an "earning assets approach" in computing the rate of return for the industries examined. Earning assets consisted of accounts receivable, inventory, plant and equipment less accumulated depreciation and land. Excluded were cash and equity and debt claims.

Table VII summarizes the rate of return behavior for selected corporate sectors. It appears that Stockfisch computed the rates of return for the period 1949-1965, but used only 1961-1965 as the base for the derivation of the discount rate. Although the data suggests that a number of distinct margins of investment existed in the economy, Stockfisch estimated the rate of return to be 15% for manufacturing and 10% for regulated public utilities.

TABLE VII. SUMMARY OF RATE OF RETURN BEHAVIOR FOR SELECTED MAJOR CORPORATE SECTORS[a]

SECTOR	TOTAL EARNING ASSETS - 1965 (BILLIONS OF DOLLARS)	PERIOD	ANNUAL AVERAGE RATE OF RETURN (%)	ANNUAL AVERAGE RATE OF RETURN (%)
Manufacturing	274,574	1949-1965	17.7	15.4
Electric Utilities	53,534	1949-1965	8.9	9.3
Gas Pipelines	8,782	1955-1965	8.5	8.6
Telephone	31,429	1949-1965	10.6	11.9
Railroads	25,203	1956-1965	4.8	4.1
Motor Carriers	1,293	1958-1964	13.0	14.7[b]
Oil Pipelines	2,793	1956-1965	14.4	15.6
Airlines	4,384	1959-1965	6.1	8.2

a. Source: Survey of Current Business, April 1964, p. S-2; and January 1967, p. S-2.

b. Average of 1961-1964 only.

The second part of Stockfisch's derivation process was based upon the allocation of business investment spending. Table VIII shows the allocation of business investment on plant and equipment by year during the five year period of 1961 through 1965. Stockfisch hypothesized that the rate of return in the manufacturing sector would also apply to the mining and commercial sectors on the grounds that competition within the unregulated sector would tend to promote equality in the rates of return. Accordingly, he weighted the manufacturing rate of return of 15% at 70% (the approximate portion the unregulated sector accounted for in investment spending) and the 10% rate for regulated utilities at 30%. Thus he estimated the overall rate of return in the corporate sector, before property taxes, at 13.5%. To this he added an estimate of the effective property tax rate at 1.5% and concluded that the pre-tax rate of return in the corporate sector was 15%.

Acknowledging that a large amount of investment, including housing and agriculture, occurs in the noncorporate sector, Stockfisch, using Goldsmith's wealth estimates (Table IX), estimated the relative importance of the noncorporate and corporate sectors at 60% and 40% respectively. In order to identify the returns in the noncorporate sector, he made the assumption that returns in the corporate sector, after corporate taxes, equalize through competition. To estimate the corporate tax figure, Stockfisch reasoned that if corporate tax is viewed as an "ad valorem" tax, a rough estimate could be obtained by dividing corporate taxes by corporate assets. Using this approach, he computed an ad valorem tax rate of 4.7%. By subtracting this rate from the 15% corporate rate of return, he estimated the return in the noncorporate sector, before property taxes, to be slightly over 10%. Stockfisch then weighted the 15% corporate return and the 10%

TABLE VIII. ALLOCATION OF BUSINESS INVESTMENT SPENDING ON PLANT AND EQUIPMENT, 1960-1965[a]
(BILLIONS OF DOLLARS)

	1961	1962	1963	1964	1965	Five Year Total	Percent
All Industries	34.37	37.31	39.22	44.90	51.96	207.76	100
Manufacturing	13.68	14.68	15.69	18.58	22.45	85.08	41
Mining	.98	1.08	1.04	1.19	1.30	5.59	3
Commercial and Other	8.46	9.52	10.03	10.83	11.79	50.63	24
Public Utilities	5.25	5.48	5.65	6.22	6.94	29.54	14
Communications	3.22	3.63	3.79	4.30	4.94	19.88	10
Railroads	.67	.85	1.10	1.40	1.73	5.75	3
Transportation, other than Railroads	1.85	2.07	1.92	2.38	2.81	11.03	5

a. Source: Survey of Current Business, April 1964, p. S-2; and January 1967, p. S-2.

TABLE IX. PRIVATE PHYSICAL ASSET HOLDINGS, CORPORATE AND NONCORPORATE SECTORS, 1958[a]
(Billions of Dollars)

CORPORATE SECTOR	
Non-Financial Institutions	489.9
Financial Institutions	10.4
Sub-Total	500.3
NONCORPORATE SECTOR	
Agriculture	182.4
Non-Farm Unincorporated	108.3
Non-Farm Households[b]	464.7
Sub-Total	755.4
TOTAL	1,255.7

a. Source: Raymond W. Goldsmith, Robert E. Lipsey and Morris Mendelson, Studies in the Balance Sheet of the United States, Vol. 99, Princeton: Princeton University Press, 1963. Table 1, pp. 68-69.

b. Total non-farm household assets less 164.7 billion of consumer durables.

noncorporate return at the 40 and 60 ratio previously noted and derived an overall estimate of 12% as the rate of return, before corporate and property taxes, for investment in the entire private sector.

His final calculation was an adjustment for inflation to counter the potential argument that the estimated rate of returns based on historical accounting data and the methodology he employed were too high because of increases in the general price level. The reason such estimates might be biased upward was because the accounting book values of assets for any given year (which constituted the denominator in the rate of return ratio) represented assets which were mostly acquired over past years when acquisition prices were lower. The value of the asset base was therefore too low and the calculated rate of return too high. Stockfisch computed the annual rate of increase in the personal consumption expenditure deflator[2] to be 1.6%, which he subtracted from the 12% rate. He therefore concluded the real opportunity rate of return to be approximately 10%.

In a recent attempt to determine whether or not Stockfisch's rate remains valid, Stampler replicated Stockfisch's methodology using updated data. As a result of this effort, Stampler concluded that,

> "Stockfisch's estimate of an unadjusted-for-inflation 12% rate of return for the private sector appears to retain substantial validity today in spite of economic traumas and upheavals experienced subsequent to its development" [10:22].

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[2] The personal consumption expenditure deflator is one of the three major price indices which combined comprise what is commonly referred to as the GNP deflator. The other two indices, gross domestic investment and government spending, were not included since they are mainly indices of input prices and were felt by Stockfisch to have a strong inflationary bias.

IV. IMPORTANT ISSUES

As was noted in Chapter III, the decade preceding the congressional hearings of 1968 was marked by considerable controversy concerning the establishment of a social discount rate. Since the promulgation of OMB Circular A-94, the level of discussion, if not necessarily the level of controversy, has increased significantly. This fact notwithstanding, several issues are deserving of review.

The first of these issues is concerned with the question of infaltion and its impact on discounting. This is a subject which has generated increasing attention in the private sector in recent years but virtually none in the public sector. It is a particularly timely and important issue and, therefore, is considered in detail. The remainder of the chapter summarizes several issues which either highlight what have been cited as weaknesses in the current policy or question the basic rationale upon which it is based.

A. INFLATION

Inflation is feared by all, criticized by most, and clearly understood by few. Infaltion is currently considered by the public as the number one domestic and economic problem in the United States. But what is inflation? Inflation is a rising trend in the general level of prices. This does not mean, of course, that all prices are necessarily rising. Even during periods of acute inflation some specific prices may be relatively constant and others may be actually falling. Nor does inflation mean that prices rise evenly or proportionally. Indeed, one of the difficulties of infaltion lies in the fact that prices tend to rise

unevenly. Some vault upward; others rise at a more leisurely pace; others do not rise at all.

There are two general theories which attempt to explain the causes of inflation. The first is what is often referred to as "demand-pull" inflation. This situation occurs when there is more money in the hands of consumers than there are goods and services to satisfy demand. Prices are "pulled" up as consumer's demand exceeds the supply available. The second theory is what has become known as "cost-push" inflation. Cost-push inflation is usually attributable to monopolistic market power -- the effective degree of discretion which those who control resources, such as unions or firms, have to set wages and prices.

Whatever the underlying reasons for its existence, the impact of inflation is widespread and can affect investment decisions of individuals, private businesses and government. The intent of this section is not to discuss the subject of inflation in detail but rather to explore its impact within the context of the issue of discounting in the Federal Government. With this in mind, two aspects of inflation as it pertains to the current discounting policy are considered. The first reviews the effect of recent inflation rates as applied to Stockfisch's computations while the second section discusses alternative methods for incorporating anticipated inflation into projected cash flows of potential investments.

1. Stockfisch's Adjustment for Inflation

Since Stockfisch explicitly adjusted for inflation in his computations, his methodology deserves reconsidering. As previously noted, when Stockfisch's procedure was replicated, his unadjusted-for-inflation rate of return of 12% remained basically unchanged. When, however, adjustments for inflation were made using more recent data, the inflation adjusted cost of capital was substantially altered. The following points are worth considering.

The first concerns an error in Stockfisch's method of computing the average rate of inflation for the period 1949-1965. In deriving the average annual rate increase in the personal expenditure deflator, Stockfisch simply subtracted the 1949 index (81.7) from the 1965 index (108.9) and divided by 16 years. Since the absolute difference of these years would vary depending on the base year chosen, Stockfisch should have derived his average annual rate of inflation by computing the relative change during the period. However, because inflation was not a particular problem during this period, a recomputation of this rate (1.8%) produces no significant change in the original figure.

Of considerably more significance is the effect on the infaltion adjusted discount rate when more recent deflators are included in Stockfisch's computations. Table X includes average annual percentage increases in the personal consumption expenditure deflator for various arbitrary periods. As in Stockfisch's methodology, an inflation adjusted rate is obtained by subtracting the computed deflators from his 12% base.

TABLE X. INFLATION ADJUSTED DISCOUNT RATES

PERIOD	AVERAGE ANNUAL PERCENTAGE INCREASE IN PERSONAL CONSUMPTION EXPENDITURE DEFLATOR	INFLATION ADJUSTED DISCOUNT RATE (12% BASE)
1949-1965	1.8	10.2
1949-1970	2.5	9.5
1949-1975	3.4	8.6
1960-1975	3.9	8.1
1965-1975	5.1	6.9
1970-1975	6.5	5.5

It is interesting to note that the higher rates of inflation in recent years have the effect of lowering the adjusted discount rate. Lower rates imply that in general more government projects would be considered acceptable, at least in terms of financial considerations.

2. Incorporating Anticipated Inflation Into Cash Flows

Regardless of whether alternative investment projects are being evaluated in the private or public sectors, certain basic elements remain unchanged. Among the first steps is to develop a projection of the amounts of cash flows, both in and out, related to the alternatives together with the time dimension of each flow. Five quantities must be estimated:

a. The amount of the initial capital outlay and any later investment.

b. The amount of cash (if any) that will be available at the end of its productive life.

c. The net increase in cash flows (if any) expected from the investment.

d. The times when the above outflows and inflows are expected to occur.

e. The expected productive life of the investment.

Considering these points, the question arises - should or should not anticipated inflation be introduced into investment analysis? Before exploring this question, the difference between real and money cash flows needs considering.

Cash flow data for capital budgeting analysis can take two forms: money cash flows (MF) and real cash flows (RF). Cash flows in money terms for an investment proposal can be given by a series of terms (MF_{1j}, MF_{2j}, . . ., MF_{tj} . . . MF_{Tj}) where MF_{tj} represents the net cash flow expected from the jth investment in period t expressed in terms of money prices for period t without any adjustment for changes over time in the general level of prices. Money cash flows are equivalent to current dollar cash flows.

Real cash flows are derived from money cash flows by a transformation involving some price index. In general, a money flow in period t_2 can be adjusted to the real terms of period t_1 by dividing the money flow by

the price index formed by the ratio of the index for t_2 to the index for t_1. A money flow of $242 in period t_2 when the index is 121 is equivalent to the real flow of $200 in period t_1 when the index is 100. That is, $200 = $242/(121/100). Real cash flows are equivalent to constant dollar cash flows.

The question of how to handle inflation in cash flow estimation can be now considered. In the public sector the policy is quite clear. OMB Circular A-94 specifies,

> All estimates of costs and benefits for each year of the planning period should be made in constant dollars. ... Estimates may reflect changes in the relative prices of costs and/or benefit components, where there is reasonable basis for estimating such changes, but should not include any forecasted change in the general price level during the planning period [8:3].

Some agencies, such as the Department of the Defense, acknowledge that inflation is often an important consideration in conducting time-phased trade-off studies. When this situation exists, analyses are required to consider inflation although such anlayses are considered supplemental to that conducted using constant dollars. Three methods are suggested for calculating project costs adjusted for anticipated inflation [11:10].

a. Inflate the cost streams first then introduce the discount rate.

b. Discount the cost streams first, then introduce inflation.

c. Apply a joint discount/inflation rate in a single calculation.

Regardless of which of these methods is employed, the adjusted net present values in all three calculations will be the same.

There has been a growing interest in the private sector concerning inflation and its impact on investment decisions with particular attention focused on new and innovative ways of dealing with this problem. The underlying belief exists that, "Significant increases in the general price level of goods and services necessitate modification of traditional capital budgeting procedures to avoid inefficient allocation of capital" [12:18].

Using the definitions of real and money cash flows introduced earlier, the following paragraphs explore one alternative means of incorporating explicit provisions for general price level changes into the traditional discounting (net present value analysis) method. A constant rate of general price level change, p, is used for simplicity although this is not a necessary constraint [12].

For a given discount rate, i, the discounted value of the jth project can be expressed in the following form:

$$MV_j = \sum_{t=1}^{T} MF_{tj}/(1+i)^t$$

where MV_j is the discounted value based on unadjusted cash flow.

If price changes at a constant rate p per year, then the transformation from money cash flows to real cash flows can be given by $RF_{tj} = MF_{tj}/(1+p)^t$. Thus RF_{tj} is the money flow of period t adjusted to the price level of period t_1. For example, when the price level is rising at a rate of 10% per period, a money flow of \$242 two periods hence is equivalent to a real flow of \$200 in current dollars, i.e. $\$200=\$242/(1.0+.1)^2$.

The adjusted discount value, RV_j, can be expressed in the following form:

$$RV_j = \sum_{t=1}^{T} RF_{tj}/(1+i)^t$$

$$= \sum_{t=1}^{T} MF_{tj}/[(1+p)\cdot(1+i)]^t$$

The adjustment of the money flows for the general price level change at the constant rate p can be thought of as an adjustment to the discount rate, i, which is then used to compute the discount value based on money flows. For every product $(1+p)\cdot(1+i)$, where p and i are known, an adjusted discount rate, a, can be calculated such that $(1+a)=(1+p)\cdot(1+i)$.

More specifically a = (1+p) + (i·p). For example, if p = .05 and i = .10, then RV_j can be obtained from the equation MV_j merely by substituting the adjusted rate, a = (.05+.10) + (.05)(.10) = .155, for the discount rate i. Clearly the real discounted value, RV_j will differ from the money discounted value, MV_j. Table XI provides a sample of adjusted factors derived utilizing the described methodology.

TABLE XI

ADJUSTED DISCOUNT FACTORS FOR SELECTED UNADJUSTED DISCOUNT RATES (i) AND RATES OF GENERAL PRICE LEVEL CHANGE (p)

UNADJUSTED DISCOUNT RATE (i)	RATES OF GENERAL PRICE LEVEL CHANGE (p)					
	0	.01	.02	.03	.04	.05
.00	.000	.010	.020	.030	.040	.050
.04	.040	.050	.031	.071	.082	.092
.08	.080	.091	.102	.112	.123	.134
.10	.100	.111	.122	.133	.144	.155
.12	.120	.131	.142	.154	.165	.176
.16	.160	.172	.183	.195	.206	.218
.20	.200	.212	.224	.236	.248	.260

Can the introduction of an adjusted discount rate change the ranking of investments? The answer may best be shown through an example. Tables XII and XIII contain data on two hypothetical investment projects. When the unadjusted discount rate equals 10%, project 1 yields the higher present value. If, however, a 5% increase in the general price level is anticipated and incorporated into the discount rate as proposed, an adjusted rate of 15.5% results. As can be seen by comparing the last column in Tables XII and XIII at the discount rate of 15.5%, project 2 yields the higher return. Figure 2 presents this example graphically.

TABLE XII

NET PRESENT VALUES OF PROJECT 1

YEAR	UNDISCOUNTED NET CASH FLOW	DISCOUNTED NET CASH FLOW @ 10%	@13%	@15.5%
0	$-283	$-283.	$-283.	$-283.
1	40	36.36	35.40	34.63
2	30	24.78	23.49	22.49
3	30	22.53	20.79	19.47
4	80	54.64	49.07	44.95
5	80	49.68	43.42	38.92
6	80	45.12	38.43	33.70
7	80	41.04	34.00	29.18
8	80	37.36	30.09	25.26
9	80	33.92	26.63	21.87
10	80	30.88	23.57	18.94
	$ 377	$ 93.31	$ 41.89	$ 6.41

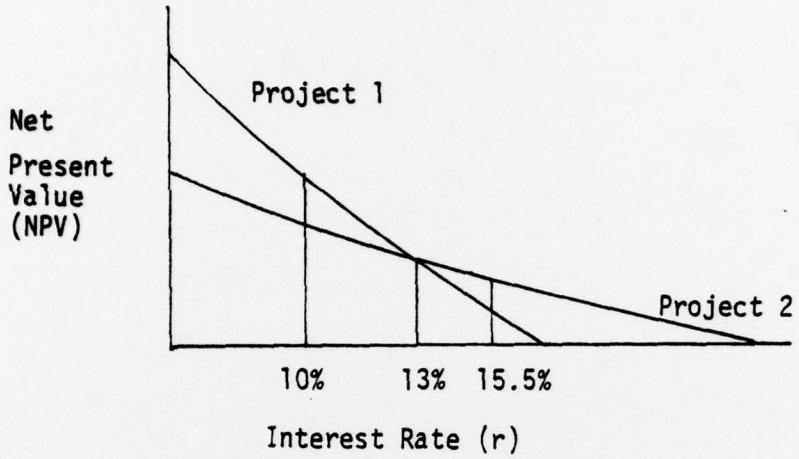
TABLE XIII

NET PRESENT VALUES OF PROJECT 2

YEAR	UNDISCOUNTED NET CASH FLOW	DISCOUNTED NET CASH FLOW @ 10%	@ 13%	@ 15.5%
0	$-283	$-283	$-283	$-283
1	80	72.72	70.80	69.26
2	70	57.82	54.82	52.47
3	65	48.82	45.05	42.19
4	50	34.15	30.67	28.10
5	50	31.05	27.14	24.33
6	50	28.20	24.02	21.06
7	50	25.65	21.25	18.23
8	50	23.35	18.81	15.79
9	50	21.20	16.64	13.67
10	50	19.30	14.73	11.83
	$ 282	$ 79.26	$ 40.93	$ 13.93

FIGURE 2

NET PRESENT VALUE CURVES OF ALTERNATIVE PROJECTS



Although the ranking changed in this example, this will not always be the case. As can be seen, at a rate of 13% the two projects have approximately the same present value. Thirteen percent represents what Fisher referred to as the ". . . rate of return over cost" [13:155]. That is the rate of interest which when used in calculating the present worth of two options, equalizes them. In the previous example, if the adjusted discount rate had been less than 13%, project 1 would have continued to yield the higher net present value.

B. ECONOMIC VERSUS SOCIAL GOALS

Not all of the members of the Joint Economic Committee of 1968 agreed with the Committee's conclusions. The basic point of departure of the dissenting members was the acceptance of the business-oriented criteria for evaluating government activity. In a separate statement the Vice Chairman of the Joint Economic Committee, Representative W. Patman, asked,

> Do we mean to say that we believe society will benefit more from a new gadget than from the construction of a new school or sewage system because the immediate financial return on the former might be 6.5 per cent as opposed to 5 per cent on the latter?

> Our society has many objectives which could never be shown on a profit and loss statement and our government has obligations to its citizens which cannot be dismissed by reference to a profit maximizing rate of return [7:22,23].

In a similar vein Committee member Senator J. Sparkman concluded:

> Unquestionably the many demands of the people upon their Government for facilities and services make it necessary that Government establish priorities for the investment of public funds. This is true because private investment seeks only economic efficiency, whereas public investment seeks objectives which are a mix of economic and social goals [7:24].

Those who concur with such statements would argue that whether or not the total benefits of a public investment warrant its undertaking is largely a social and political question, not a strictly economic one. Both the benefits and costs of many public investments are multidimensional and are inappropriate subjects for straightforward evaluation in terms of present values of economic prices.

C. BUDGET CONSTRAINTS

In making investment decisions, every organization must try to satisfy one of two broad guidelines:

1. minimize costs subject to some level of effectiveness; or
2. maximize effectiveness subject to fiscal constraints.

No organization can do both simultaneously. In a recent article, Commander Rolf Clark uses this concept as a basis for rejecting the use of the discounting methodology in situations where the decisionmaker is required to maximize effectiveness subject to budgetary constraints [14].

Commander Clark provides a simple intuitive example as a means of supporting his hypothesis. In his example it is assumed that the decisionmaker's budget for the next year is $100 which cannot be exceeded. If the next year's costs are assumed to be $101, discounting the $101 will diminish its present value, but will not keep the cost within the $100 budget. In

such a situation, Commander Clark reasons that if next year's costs are to be discounted, then the budget should be also. But if both budget and costs are discounted, the discounting process is in effect neutralized.

The decisionmaker in the public sector thus is faced with conflicting guidance. On one hand he is required to discount costs alone while on the other hand he is required to remain within fiscal guidance limits. Commander Clark's point is that the discounting and fiscal guidance policies are compatible only if both costs and budgets are discounted at the same rate, a situation which, as previously noted, would nullify the effect of discounting.

D. ARTIFICIAL GAINS

Another argument presented in the same article points out the fact that discounting can be intentionally (or unintentionally) misused resulting in possible incorrect decisions. If, for example, an organization desires to make a particular program more attractive to the decisionmaker, certain program costs could be deferred and thus discounted by a greater factor. That is, the net present value of an investment can be significantly reduced by rearranging and stretching out costs. Table XIV illustrates how the rearrangement of outlays can reduce the net present value of one program as compared with another program even though the total undiscounted investments costs are equal.

TABLE XIV NET PRESENT VALUE OF ALTERNATIVE CASH FLOWS

(i = 10%)

YEAR	PROJECT A OUTLAYS PER YEAR	DISCOUNTED OUTLAYS PER YEAR	PROJECT B OUTLAYS PER YEAR	DISCOUNTED OUTLAYS PER YEAR
1	$ 50	$ 45.45	$300	$272.70
2	5	4.13	5	4.13
3	5	3.76	5	3.76
4	5	3.42	5	3.42
5	300	186.30	50	31.05
Total	$365	$243.06	$365	$315.06

It is for this reason Commander Clark concludes, "... when program cost comparisons are made in constant (undiscounted dollars) such artificial gains will be less effective"[14:17].

The counter argument is that costs should be deferred as much as possible unless the penalty for such action is greater than the return rate. If in the example cited it is assumed that either alternative will satisfactorily attain the desired objective, then Project A would be preferable and would result in the more efficient use of resources.

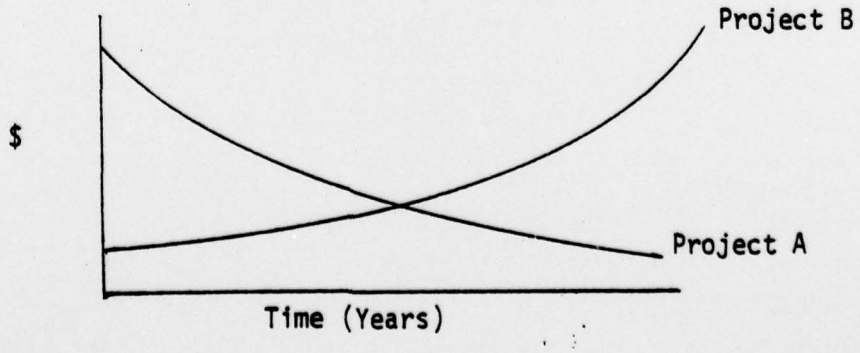
E. DEFERRED COSTS

It can also be argued that when programs are selected that have the lowest net present value because costs are deferred (either intentionally or not), future generations are forced to pay for decisions made in the present. If one considers a hypothetical problem of trying to decide between two equally effective alternatives this point becomes clear.

Let it be assumed that the first alternative (Project A) involves purchasing highly sophisticated equipment which requires minimal labor to operate and maintain. The second alternative (Project B), which has the lower net present value, is labor intensive and requires virtually no equipment. Graphically the cash flow profiles might look as follows:

Figure 3

Cash Flows of Alternative Projects



In choosing alternative A, the majority of the costs will be absorbed by those making the decision to proceed with the project. Selection of Alternative B, however, commits those in more distant years to pay costs (e.g. retirement expenses) for which they had little or no input.

Such logic may be countered by pointing out the fact that if the proper social discount rate were used and Project B found preferable to Project A, then society would have more cash to invest in the project in the future than the difference between B and A. As noted in Chapter II, a dollar not spent today can be invested until needed and the interest earned as such investments can be used to pay part of the future cash requirements.

V. CONCLUSION

Although the concept of discounting is relatively straightforward and has gained wide acceptance in the private sector, its application in the Federal Government has been less clearly defined. The controversy over discounting in the public sector, which transpired for many years, culminated in 1968 when the Joint Economic Committee on Economy in Government undertook the task of exploring the issue in depth. During these hearings, leading economists and government officials who testified were virtually unanimous in agreement that the discounting of future funds flow in public investment analysis was appropriate.

Nevertheless, as was seen in the previous chapter, the concept of discounting is not without its flaws and detractors. For example, Commander Clark has argued that budget constraints cause discounting to become an irrelevant requirement in the decision process. Such reasoning, however, should not be employed to conclude discounting is without value. It is equally true that while at each level the aggregate undiscounted dollar cost of the alternatives chosen must remain within the undiscounted dollar constraint placed upon the manager at that level, discounting may still prove useful for choosing among alternatives and providing information to the next decision level.

In a similar vein, the issues of artificial gains through cash flow manipulations and the impact of deferred costs on future generations, although thought provoking, do not provide a convincing argument against the validity and usefulness of the discounting concept. As with any system or procedure, the potential for misuse or misapplication exists.

Discounting of itself does not cause a decision to be good or bad. It is the responsibility of the decisionmaker to be aware of such factors and to incorporate them into the decision process.

Of all the potential issues which are relevant to the current discounting policy, inflation is considered to present the greatest challenges. In reviewing the derivation of the 10% rate, it was observed that when more recent inflation rates were introduced into Stockfisch's computations, his adjusted rate ranged between 10.2% and 5.5%. In other words, depending on the period chosen, significantly different rates would result. The high inflation rates of the 1970s and the resultant effect on Stockfisch's adjusted rate, imply that the cost of capital is relatively cheap and that more projects are economically justifiable.

Of equal importance is the question of whether or not anticipated inflation rates should be incorporated into projected cash flows of proposed public projects. One such method was discussed and was shown to have potential implications on the ranking of alternative projects. The obvious and certainly the most difficult aspect of such an approach or any similar approach would be in determining accurate projections for general price level increases. Although many indices are available to report what has happened in the past, no model presently exists which can be relied upon with any degree of confidence for making projections into the future.

In summary, it is concluded that the general policy requiring the use of discounting in the public sector is appropriate. Whether the social time preference theory or a variation of the opportunity cost theory gives the best approximation of the social discount rate is a question that has no "correct" answer. The selection by the Joint Economic Committee of the opportunity cost of displaced private spending as the basic criterion for

determining the social discount rate is considered reasonable and as defensible as any of the alternatives.

What does appear to be significantly less defensible is the 10% rate. The problems associated with infaltion raise serious questions concerning the validity of this rate both in its derivation and its application to future cash flows. Further study in the area by OMB appears appropriate.

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